Society for the Encouragement of Arts, Manufactures, and Commerce,

JOHN-STREET, ADELPHI, LONDON, W.C.

EXAMINATION PAPERS

SET AT THE

EXAMINATIONS OF THE SOCIETY OF ARTS,

HELD IN APRIL, 1868,

THE COUNCIL AND OFFICERS

OF THE

Society for the Encouragement of Arts, Manufactures, & Commerce,

FOR THE 114TH SESSION, 1867-8.

Council.

H.R.H. THE PRINCE OF WALES, K.G., President.

EXAMINATION PAPERS

ARITHMETIC.

THREE HOURS ALLOWED.

1. The fore-wheel of a coach is 8¼ feet round; the hind wheel 12½ feet round. How many more revolutions will the former make than the latter in the course of a mile and a quarter?

2. How many English ells of cloth, at 19s. 9½d. per ell, should be given in exchange for 47 yards 2 qrs., at 17s. 5d. per yard?

3. If £7 14s. 7d. pay the wages of 10 men and 3 boys, how many persons will £12 19s. 7d. pay, a man earning 5 times as much as a boy?

4. If 2 engines of 12 horse-power raise 3,200 gallons of water from a depth of 75 fathoms in 45 minutes, in what time would the same engines raise 4,000 gallons from a depth of 50 fathoms?

5. Find by Practice the value of 267⅘ cwts. of sugar at £2 14s. 6d. per cwt.

6. Calculate the value of 215 acres, 1 rood, 20 poles, at £2 10s. 6d. per acre.

7. How many articles, bought at 1s. 4½d. each, must I sell at 1s. 9d. to make a profit of £2 14s.?

8. What will be the carriage of ⅞ cwt. for 80 miles at the rate of a farthing a lb. per mile?

9. In what time will £164 5s. at 5 per cent. per annum, gain the same interest as £75 12s. 6d. gains in 18¼ years at 4½ per cent. per annum?

10. A and B work together for a fortnight; A works 9 hours a day throughout; B works ten hours a day the first week, but only 7 hours a day the second. They earn £11 1s. 8d. How much ought each to receive?

11. Exchange into decimal coinage 1,000 francs 50 centimes, the rate of exchange being 25 francs 17 centimes per £.

12. An income of £150 10s. is liable to a tax of £4 7s. 6d. What is the tax on £361 4s.? Work by decimal currency, a £ being the unit.

13. Change £32 into French money at the rate of 25 francs 80 cents per £.

14. Subtract 3 roods, 39 poles, 30 square yards, 2 square feet, 35 square inches, from 1 acre.

15. What is the difference between the simple and the compound interest of £350 for 3 years, at 5 per cent. per annum?

16. If a ship be insured for 91⅔ per cent. of its value, the whole value being £6,968, what would a person lose who owned ⅔ of it in the event of its being lost?

17. By selling sugar at 6d. per lb. a grocer clears ⅛ of his outlay. He lowers the price to 5½d. What does he now clear per cent.?

18. If goods worth £1,200 are to be insured at 1½ per cent, to what amount must they be insured so that in case of loss the person insuring them may recover the value of both the goods and the premium?

19. During the first six months of the year the income tax is 7d. per £; but during the last six months it is 5d. per £: what is the gross annual income of a gentleman who receives £819 after deducting income tax for the year?

20. Bought wheat at 61s. a quarter, payable in 4 months: how must I sell it the same day so as to make my immediate gain 5⅚ per cent., giving 7 months' credit?

21. A can do ½ of a work in 4 hours; B can do ¾ of the remainder in 2 hours; and C can then finish it in 20 minutes. In what time could the three together perform the work?

BOOK-KEEPING BY DOUBLE ENTRY.

THREE HOURS ALLOWED.

1. Journalise and post, in proper technical form and language, the following imaginary transactions, and make out from the ledger a trial balance, a profit and loss account, and a balance-sheet.

On 1st January, 1868, D. Scott has assets and liabilities as follows:—

ASSETS.

	£	s.	d.
Business premises, valued at	500	0	0
Wine	2,000	0	0
Due by J. Wall	205	0	0
Bills receivable	352	0	0
Cash	605	12	4

LIABILITIES.

	£	s.	d.
Bills payable	557	0	0
Due to W. Brown	44	0	0

On 1st January, 1868, T. Jones is taken into partnership. T. Jones's capital is composed of brandy valued at £2,000 and £1,000 in cash.

N.B.—The capital and drawings of the partners are subject to interest at 5 per cent. per annum, and the net balance of profit and loss is divisible equally between them.

1868.			£	s.	d.
Jan. 1		Advanced for petty cash	10	0	0
„	„	Paid cash for purchase of additional business premises	200	0	0
„	3	Discounted S. Nokes's acceptance for £200, and received in cash £197 10s., and allowed for discount £2 10s.	200	0	0
„	6	Brought wine for cash	342	10	0
„	„	Sold brandy for cash	845	0	0
„	„	Paid cash for our acceptance to J. Wilson due this day	257	0	0
„	9	Bought brandy of F. Black	400	0	0
„	10	Cash drawn out by D. Scott	200	0	0
„	13	Sold G. Green wine	500	0	0
„	„	Received from G. Green (and cancelled) our acceptance to him	300	0	0
„	„	Received G. Green's acceptance to us at two months	200	0	0
„	14	Received amount due by J. Wall —viz., £200 in cash, and allowed for discount £5	205	0	0
„	16	Paid amount due to W. Brown— viz., £42 in cash, and received for discount £2	44	0	0

Jan.	20	Sold J. Wilson brandy	240	0	0
„	„	Sold, ditto, wine	800	0	0
„	„	Received J. Wilson's acceptance at twenty-one days	1,040	0	0
„	25	Received consignment of cigars from J. Thompson, invoiced at	100	0	0
„	30	Bought of J. Wall, the schooner *Dolphin*	2,000	0	0
„	„	Paid J. Wall, cash	1,000	0	0
„	„	Accepted J. Wall's draft at two months	1,000	0	0
„	31	Paid salaries of clerks	30	0	0
„	„	Received Johnson and Son's account for carriage of wine during the month of January	4	3	0
„	„	Trade charges paid out of petty cash to this date	8	9	0
		Interest on amount of capital drawn out by D. Scott........		11	6
		Interest on D. Scott's capital....	12	15	2
		„ T. Jones's „	12	10	0
		Estimated wear and tear of business premises................	10	0	0
		Stock of wine on hand	1,250	0	0
		Stock of brandy on hand	1,310	0	0

2. What is the use of a trial balance?

3. How is the profit-and-loss account affected?

(1.) If expenditure which ought to have been charged to it is charged to capital?

(2.) If receipts are credited to it which ought to have been credited to capital?

4. If, on examining the books, it be found that the following entry: — " Interest on T. Jones's capital £12 10s.," has been journalised and posted as if it had been " interest on amount of capital drawn out by T. Jones, £12 10s.," what journal entry or entries would be necessary to correct the error?

ALGEBRA.

THREE HOURS ALLOWED.

1. Explain the ordinary system of arithmetical notation.

Show that, if a number of six figures be formed by the repetition of any three figures in the same order, the resulting number will be divisible by 7, 11, and 13.

2. If $ax^2 + bx + c$, and $ax^2 + mbx + m^2c$ have a common measure, then $(m + 1)^2ac = mb^2$.

3. Simplify the expressions,

$$\left(\sqrt{\frac{a+x}{x}} - \sqrt{\frac{x}{a+x}} \right)^2 - \left(\sqrt{\frac{x}{a}} - \sqrt{\frac{a}{x}} \right)^2$$

$$1 + \frac{x}{a} + \frac{a}{x} + \frac{x^2}{a^2} + \frac{a^2}{x^2} + \left(\frac{x^3}{a^2} - \frac{a^3}{x^2} \right) \frac{1}{x-a}$$

4. A man having a capital of £P spends it all in the purchase of certain shares, each of which pays a dividend of £d; and he buys at such a rate that, when the shares have risen £r each, he gains £q by selling out. When the shares have fallen to their original price he again invests all his money in them. Find the alteration in his income, supposing a brokerage of £b a share is paid for purchasing.

5. Solve the equation $ax^2 + bx + c = 0$

If α β be its roots, prove that
$ax^2 + bx + c = a (x - \alpha) (x - \beta)$

6. Determine the number of permutations which can be formed out of n things taken r at a time.

7. State and prove the algebraical theorem upon which the arithmetical " Double Rule of Three" depends; and make out and work out an example in illustration of it.

8. The arithmetic mean between two numbers exceeds the harmonic by 1, and twice the square of the arithmetic mean exceeds the sum of the squares of the

geometric and harmonic means by 11; find the numbers.

9. Write down the rth term of $(a - x)^n$.

If a_0, a_1, a_2, &c., be the co-efficients of the 1st, 2nd, 3rd, &c., . . . terms respectively, of the expansion of $(1 + x)^n$, find the value of $a_0 a_1 + a_1 a_2 + a_2 a_3 + $ &c., $\ldots + a_{n-1} a_n$.

10. Prove that the difference between the interest and discount upon any sum is the interest upon the discount.

If this difference for £420 for one year be £1, find the rate per cent.

11. A man throws with three dice on the condition that, if he throws 10 exactly he shall receive a sovereign; find the value of his expectation.

12. Sum the series $1 - 3 + 5 - 7 + $ &c. to n terms.

GEOMETRY.

THREE HOURS ALLOWED.

1. Show how to bisect a given rectilineal angle. How would you do this graphically?

2. If from a point within a triangle straight lines be drawn to the extremities of the base, the sum of these lines shall be less than the sum of the sides of the triangle, but they shall include a greater angle.

3. Parallelograms upon the same base, and between the same parallels, are equal to one another.

4. Describe a parallelogram that shall be equal to a given rectilineal figure, and have an angle equal to a given rectilineal angle. Does not this include the last proposition of Euclid, book ii.? Explain fully.

5. If a straight line be divided into two equal and also into two unequal parts, the squares of the two unequal parts are together equal to twice the square of half the line, and twice the square of the line between the points of section.

6. From a given point draw a straight line to touch a given circle.

7. Upon a given straight line describe a segment of a circle which shall contain an angle equal to a given rectilineal angle.

8. Show how to describe an equiangular and equilateral pentagon in a given circle.

9. If the sides of two triangles, about each of their angles, be proportionals, the triangles shall be equiangular.

10. If four straight lines be proportionals, the rectangle contained by the means is equal to the rectangle contained by the extremes.

11. The rectangle contained by the diagonals of a quadrilateral figure inscribed in a circle is equal to both the rectangles contained by the opposite sides.

12. Every solid angle is contained by plane angles, which together are less than four right angles.

PROBLEMS.

1. If the area of a square and a triangle be equal, the perimeter of the triangle will be greater than the perimeter of the square. Prove this. Generalise this proposition.

2. Given an angle, the side opposite to it, and the difference of the other two sides of a triangle; construct the triangle geometrically.

3. If from the three angles of a triangle lines are drawn to the middle points of the opposite sides, prove that these lines meet in a point, and show that the sum of the squares of the lines from the common point of concourse to the angles of the triangle is equal to one-third of the sum of the squares of the sides of the triangle.

4. If from any point in a circular arc perpendiculars be drawn upon the bounding radii, the distance of their feet is a fixed quantity.

5. If two circles intersect, their common chord will bisect the common tangent of the two circles. Prove this. What analogous proposition can be established with respect to two circles which do not intersect?

6. Two circles (1) and (2) touch one another, and

another circle (3) is described which touches both and includes them, having its centre in the line which passes through the centres of (1) and (2). Let a common tangent be drawn to (1) and (2), find the relation between the radii of circles which are drawn to touch (1) (3) and the tangent, and to touch (2) (3) and the tangent.

7. Of all polygons having equal perimeters and the -same number of sides, the equilateral polygon has the greatest area.

8. With a given radius, describe a circle which shall touch two given circles. Show when the problem is impossible, when there is only one such circle, and when there will be two such circles.

9. Show geometrically that the rectangle contained between two straight lines is a mean proportional between their squares.

10. Two equal circles are drawn intersecting in A and B; a third circle is drawn with centre A, and radius less than A B, cutting the former circles in D and C; show that B, D, C are in the same straight line.

MENSURATION.

THREE HOURS ALLOWED.

1. The area of a triangle is 39 ft. 117·45 in., and its altitude 7·75 ft.; find the base.

2. Find by duodecimals the area of a triangle, the sides of which are 4 ft. 3 in., 5 ft. 8 in., and 7 ft. 1 in.

3. How much paper, $\frac{3}{4}$ths of a yard wide, will be required to paper a room which is 19 ft. 11 in. long, 14 ft. 7 in. wide, and 11 ft. 3 in. high? And how much will it cost at $2\frac{1}{4}$d. a yard?

4. Find the side of a square which costs £33 16s. $10\frac{1}{2}$d. paving at 10d. a yard.

5. A wall measures 100 ft. 10 in. in length, and 15 ft. 7·2 in. in height, and is $4\frac{1}{2}$ bricks thick;—how many rods of brickwork does it contain?

6. The diameter of a circular window is 3 ft. 7 in.; what will be the cost of glazing it at 1s. 6d. a foot?

7. Prove that the area of a circle $= \frac{1}{2}$ circumference ✗ radius. What ratio does the circumference of a circle bear to its diameter?

8. The paving of a semicircular court, at 3s. 4d. a yard, costs £115 10s.; find the length of the circular part.

9. An iron cylindrical bar is 2 yards long and 6 inches in circumference; find its volume and weight; the weight of a cubic foot of the iron being 7,500 ounces.

10. Find the surface of a right cone, the base of which is 3 inches in diameter and the height 4 inches.

11. Find the volume of a pyramid when its base is a triangle.

12. Given the areas of the two ends of a frustum of a pyramid and its height, find the solid content.

13. Given that the volume of a cone is equal to one-third of the cylinder with the same base and height, prove that the volume of a sphere is two-thirds of the circumscribing cylinder.

TRIGONOMETRY.

THREE HOURS ALLOWED.

1. Find sec. A when $\dfrac{1 + \cos. 2A}{1 - \sin. 2A} = \tan. A$.

2. What is the ratio between 1° 25′ English and 1° 25′ French?

3. Investigate formulas for the sums and differences of the sines and cosines of two angles.

4. Find A when

   (1.) Cos. A — cos. 2A $=$ sin. 3A.
   (2.) Cos. A + cos. (120 + A) + cos. (120 — A) $= 0$.
   (3.) Sin. 7A — sin. A $=$ sin. 3A.

5. Given the ratios of the sines of the angles of a triangle, find the angles.

6. The elevation of a tower on a horizontal plane is observed; on approaching a feet nearer, the elevation is

45°, and b feet nearer still, it is the complement of the first angle; show that the height is $\dfrac{ab}{a-b}$

7. A B C D is a quadrilateral inscribed in a circle; $\angle$ D A C $= a$, $\angle$ C A B $= \beta$, $\angle$ D B A $= \gamma$; A B $= c$, then C D $= \dfrac{c \sin. a}{\sin. (a+\beta+\gamma)}$

8. Solve the equation,
$$2 + \cot. {}^2x = 3 \sec. {}^4x - \tan. {}^2x.$$

9. Find the radius of the circle which passes through the vertex A of the triangle A B C, and touches the base B C at its bisection D.

10. If A, B, C, be the angles of a triangle, show that cos. $\frac{1}{2}$A + cos. $\frac{1}{2}$B is greater than cos. $\frac{1}{2}$C.

11. If the sides of a triangle be $a + b$, $a + c$, and $b + c$, its area $= \sqrt{(a + b + c)\,abc}$.

12. If a triangle be formed of the perpendiculars A D, B E, and C F, from the angles A, B, C, of the triangle A B C on the opposite sides, and if A_1 B_1 C_1 be the angles of the new triangle, A_1 being opposite A D.
$$2(a \cos. A_1 + b \cos. B_1 + c \cos. C_1) = \frac{bc}{a} + \frac{ac}{b} + \frac{ab}{c},$$
a, b, c, being the sides of the original triangle.

13. If a degree of longitude at the equator be 69 miles, what will be the length of a degree in latitude 60°?

14. The sides and angles of the polar triangle are respectively the supplements of the angles and sides of the original triangle.

15. Prove the formulas:—
   (1.) Cos. $c = $ cos. a. cos. b + sin. a. sin. b. cos. C.
   (2.) Cos. a. sin. $b = $ cos. b. cos. c + cos. A. sin. C.

16. Prove the theorems:—
   Cos. $\frac{1}{2}$ c. cos $\frac{1}{2}$ (A + B) $=$ cos $\frac{1}{2}$ $(a + b)$ sin. $\frac{1}{2}$ C.
   Sin $\frac{1}{2}$ c. cos. $\frac{1}{2}$ (A — B) $=$ sin. $\frac{1}{2}$ $(a + b)$ sin. $\frac{1}{2}$ C.

CONIC SECTIONS.

THREE HOURS ALLOWED.

SECTION I.—GEOMETRICAL CONICS.

1. What is a Cone? Show that an ellipse, a parabola, and a hyperbola may be each projected into a circle. What lines will be projected into diameters of the circle perpendicular to each other?

2. Define a tangent. Show that in a parabola the sub-tangent is equal to twice the abscissa, whether the axes are rectangular or not.

3. Prove that the perpendicular from the focus on the tangent of a parabola intersects the tangent in the line that touches the curve at the vertex. Hence show that $SZ^2 = SP \times SA$.

4. If two chords of a parabola intersect one another the rectangles contained by these segments are as the parameters of the diameters which bisect the chords. What is the corresponding theorem in the ellipse?

5. Define an ellipse, and draw a tangent to it from any point on the curve.

6. Prove the following properties of an ellipse:—

$$\begin{aligned} (^1)\ & \text{CN} \times \text{CT} = \text{CA}^2 \\ (^2)\ & \text{SP} \times \text{S'P} = \text{CD}^2 \end{aligned}$$

7. If QV is any ordinate to the diameter PCP′ of an ellipse, and CD is conjugate to CP, then
$$QV^2 : PV \times VP' :: CD^2 : CP^2$$

8. Prove that the difference of the focal radii of a point on the hyperbola is equal to the transverse diameter.

9. If through any two points P and P′ of a hyperbola a line is drawn intersecting the asymptotes in Q and Q′ prove that PQ $=$ P′Q′. What form does this theorem take when QQ′ is a tangent?

10. Define the circle of curvature and chord of curvature. What is the value of the chord of curvature passing through the focus in the parabola?

SECTION II.—ANALYTICAL CONICS.

11. Find the equation to the line passing through (a, b) and perpendicular to $bx + ay - ab = 0$.

12. Determine the condition that three given points should be on the same straight line.

13. Find the equation to the system of circles which pass through two given points, and show analytically that the centres all lie in the straight line bisecting at right angles the line joining the two given points.

14. What is the equation of the tangent of the ellipse? and prove that that at the extremity of the latus rectum intersects the axis in the point of intersection with the directrix ?

15. Prove analytically the theorems contained in 2, 3, 6, 8, 9 of the preceding section.

16. What is a locus? Prove that the locus of the point of intersection of a tangent to a rectangular hyperbola with the perpendicular on it from the centre is the curve whose equation is $r^2 = a^2 \cos. 2\theta$.

17. Show that the equation to the ellipse may be put under the form $x^2 + y^2 = c^2$.

NAVIGATION AND NAUTICAL ASTRONOMY.

THREE HOURS ALLOWED.

SECTION I.

1. Define a great and a small circle on the surface of a sphere. Investigate the relation between the circumference of a small circle and that of the large circle parallel to it.

2. Show that in any spherical triangle the sum of the three angles is greater than two and less than six right-angles; and that the difference between the sum of any two angles and the third is less than two right-angles.

3. Obtain an expression for the cosine of the angle of a spherical triangle in terms of the sides.

SECTION II.

1. State Napier's rules for the solution of a right-angled spherical triangle, and prove them in the case where the complement of one of the angles is the middle part.

2. Given two sides and the included angle of a spherical triangle, find the third side in a form adapted to logarithmic calculation.

3. What is meant by the spherical excess; obtain an expression for the area of a spherical triangle, and find it when the three sides are given.

SECTION III.

1. Find the compass course and distance from A to B. Given—

Lat. A 37° 18' N. Var. 2 pts. W. Long. A 39° 18' E.
„ B 37° 18' N. Dev. 10° 30' E. „ B 48° 33' E.

2. Find the compass course and distance from A to B. Given—

Lat. A 44° 53' S. Var. 1½ pts. E. Long. A 97° 18' W.
„ B 78° 16' S. Dev. 8 35' W. „ B 121° 44' W.

3. On June 25th, at noon, a point of land in latitude 18° 13' N., long. 133° 25' W. bore by compass N.N.E distant 18 miles. Ship's head E., deviation 10° 40' E., variation 1 point W. Afterwards sailed by compass as follows during the next twenty-four hours :—

K.	$\frac{1}{10}$	Courses.	Wind.	Leeway.	Deviation.
57	5	E. b. N.	W.N.W.	1½	3° 20' E.
41	6	S.S.E.	N.W.b.N.	1	0° 56' W.
48	9	S.W. b. W.	E.S.E.	2	8° 34' W.
65	7	N.E. b. E.	S.E.	1¾	10° 50' E.

A current set the ship during the last four hours S.W. by compass 2½ miles an hour. Required the latitude and longitude on June 26th at noon.

SECTION IV.

1. Define the terms *course, distance, departure,* and *rhumb-line ;* and show by a diagram how *departure* is measured. Obtain equations connecting (1), *course, distance, and departure,* (2), *course, distance,* and *diff. lat.* (3), *course, diff. lat.* and *dep.*

2. Write down and prove the formula employed in Mercator's sailing. How could you construct a Mercator's chart ?

3. Obtain an expression for the distance in sailing on a great circle from one point to another.

Find the distance from A to B.

Lat. A 12° 18' S. Long. A 18° 23' W.
„ B 33° 25' N. „ B 44° 15' W.

SECTION V.

1. On June 10, 1868, the observed mer. alt of Sirius (zenith N. of star) was 32° 18' 25". Index cor. − 3' 40" height of the eye above the sea 21 feet. Required the latitude.

2. On July 2, 1868, in long. 54° 25' W. the observed mer. alt., moon's upper limb, was 54° 18' 30" (zenith S. of moon). Index cor. + 5' 35". Height of the eye, 24 feet. Required the latitude.

3. June 1, 1868, at 8h. 20m. a.m., in lat. 18° 20' S., long. 100° 40' W. the obs. alt. sun's L.L. was 22° 42' 20", when the sun bore by compass, N. 67° 18' E. (Ship's head being W., dev. 11° 35' W.) Index cor. − 4' 5", and the height of the eye 17 feet. Required the variation of the compass.

SECTION VI.

1. Define the terms *right ascension, declination, latitude,* and *longitude* of a heavenly body ; *amplitude* and *azimuth.*

Show how to find the latitude of the observer by the observed meridian altitude of a heavenly body ; the zenith being north of the body and the declination being south.

2. Prove the rule for finding the variation of the compass by the observed amplitude of the sun.

3. Prove the rule for finding the latitude by two observed altitudes of different heavenly bodies at the same time.

SECTION VII.

1. Jan. 15, 1868, at 6h. 15m. a.m., in lat. 60° 15' S. long. 110° 10' W. the obs. alt. Sun's L.L. was 18° 38' 50". Index cor. + 3' 10", height of the eye 18 feet, when the chronometer showed 1h. 32m. 30s. Required the longitude.

On Jan. 1, at noon, the chronometer was slow on Greenwich mean time 2m. 3s. ·4, and losing 8·5s. daily.

2. Sept. 1, 1868, in lat. 49° 10' N. long. 31° 10' W. the following observations were taken :—

	Obs. alt. α Arietis.	Obs. alt : moon's L.L.	Obs. dist. F.L.
	43° 43' 50"	30° 36' 30"	58° 23' 10"
Index cor.	+ 1' 10"	− 1' 35"	− 1' 45"

and the height of the eye was 15 feet. Required the longitude.

SECTION VIII.

1. Describe the sextant, and prove the rule by which it is graduated.

2. To what errors of adjustment is the sextant liable ? Show how they may be remedied.

PRINCIPLES OF MECHANICS.

THREE HOURS ALLOWED.

1. What cases of equilibrium in forces acting on a particle are evidently true ?

2. State the proposition commonly called the parallelogram of forces. Assuming its truth for the direction of the resultant, prove it for the magnitude.

EXAMPLE.—Two forces acting on a particle are inclined to each other at an angle of 30°, one force being equal to four pounds, and the other to six ; find the magnitude of their resultant.

3. Enunciate the experimental laws of friction considered (1) statically, (2) dynamically.

EXAMPLE 1.—A copper cubical box, half full of water, is placed on an oak table, which is slowly tilted up ;

determine whether it will slide or topple over. (Co-efficient of friction=·62.)

EXAMPLE 2.—If a plane whose inclination to the horizon is 30°, be so rough as just to support a body, find the least force that will drag the body up it, the weight being supposed equal to a ton.

4. Investigate the condition of equilibrium of two forces acting in any direction at the extremities of a lever.

EXAMPLE.—A lever 12 feet long will balance at two feet from one end, but when a weight of 50lbs. is hung from the other end it balances at two feet from that end; find the weight of the beam.

5. Define the centre of gravity of a body. Show how to find from elementary principles the centre of gravity of any regular figures which you may select.

EXAMPLE.—A triangle has 3, 4, 5 for its sides; find the distance of the centre of gravity from each side.

6. State the laws of motion. How does Attwood's machine experimentally prove them?

7. Prove that if a body be urged by a constant and uniform force, the space which it describes from the beginning of the motion is equal to half the product of the force and the square of the time.

EXAMPLE.—Two weights of 97 and 96 lbs. hang over a fixed pulley; find the space descended by the heavier weight in 8 seconds.

EXAMPLE.—A stone, thrown at an angle of elevation of 45° from the top of a tower, fell in four seconds at a distance of 60 feet from the base; find the height of the tower.

9. Explain the phrase "Modulus of a Machine."

EXAMPLE.—The diameter of the piston of an engine is 80 inches, the mean pressure of the steam is 12 lbs. per square inch, the length of the stroke is 10 feet, the number of strokes is 11 per minute. How many cubic feet of water will it raise per minute from a depth of 250 fathoms, its modulus being ·6?

10. What is meant by impulsive action? What is the fundamental principle in the solution of problems upon this action? If two inelastic bodies impinge, prove the formula for their common motion after impact.

EXAMPLE.—A sphere weighing 2lbs., and moving with a velocity of 20 feet per second, meets another weighing 5lbs., and moving with a velocity of 5 feet per second. Determine their common velocity after impact.

11. Define the terms "radius of gyration," "moment of inertia."

EXAMPLE.—Find the moment of inertia of a sphere revolving about a diameter.

12. Define vis viva, and state upon what its utility depends. Investigate the motion of a ball inside a cylinder rolling on a horizontal plane.

13. Describe any recently invented instruments for measuring and registering the pressure of the wind. Explain clearly in what way the wind turns the sails of a windmill, and describe the best form and proportion of the sails.

PRACTICAL MECHANICS.
THREE HOURS ALLOWED.

1. Define a pinion, a rack, a crown-wheel, an annular wheel, the pitch-circle of a toothed wheel, and the pitch of a screw. Distinguish between a right-handed and a left-handed screw. How are screws cut in a lathe?

2. Explain the following contrivances:—(1) A mangle-wheel; (2) a ratchet-wheel; (3) a fusee; (4) a heart-wheel; (5) the Geneva stop.

3. Describe some method of connecting two parallel shafts by a single belt and wheelwork, so as to enable the continuous rotation of one shaft to be communicated to the other, either in the same or in opposite directions. How may the rotation of the second shaft be stopped when required?

4. Two parallel axes, which do not overlap, are so close together as to be nearly in the same line, and it is

wished to communicate motion from one to the other, so that the axes shall rotate in opposite directions, with angular velocities in the ratio of 2 to 3. Find a train of wheels by which this may be done.

5. Explain the necessity of providing turning lathes with contrivances for varying the relative velocities of the mandril and foot-wheel, and describe some arrangement for this purpose.

6. Mention some examples of aggregate motion. Describe any form of self-acting drilling machine, whereby a drill is made to rotate rapidly and at the same time to advance slowly.

7. Explain the principle of the movement adopted in machinery for twisting strands into a rope.

8. Describe the great improvement introduced by Watt into the construction of the steam-engine. Distinguish between single-acting and double-acting engines.

9. Describe the construction of a piston. Explain the method adopted for keeping the piston and piston-rods steam-tight.

10. Describe the locomotive slide-valve, and explain its action. Why is the use of this slide-valve restricted to engines of short stroke?

11. What do you mean by lead, lap, and cushioning? In what way does lap ensure expansive working? When is lead necessary?

12. Explain the principle of the movement known as Watt's parallel motion.

MAGNETISM AND ELECTRICITY.
THREE HOURS ALLOWED.

1. What is the nature of magnetism, and how is it related to an electric current?

2. Describe the construction and use of the dipping-needle.

3. State the source and mode of correcting any particular kind of deviation to which a ship's compass is liable.

4. Mention any periodic phenomena by which the earth's magnetism is supposed to be influenced.

5. Explain diamagnetism, and state some substances by which this property is manifested.

6. State your views of the nature of electricity, and your reasons for entertaining them.

7. What is the difference between an electrometer and an electroscope? Describe the electrometer of Coulomb, or Thomson.

8. Explain the construction and use of a condenser.

9. By what means can you show that Franklinic and Voltaic electricities are identical?

10. Describe the construction of a Grove's cell, and explain how the current is produced.

11. Describe the process of electro-gilding.

12. Describe an "astatic" needle. Under what conditions is it actually astatic; and when these are not fulfilled, determine its position of equilibrium.

13. Explain the cause of electro-dynamic rotation, as exhibited in any well-known apparatus.

14. Explain the construction of an inductorium, and the means of intensifying its action.

15. Explain the magneto-electric telegraph of Henley, Siemens, or Wheatstone.

16. Describe the construction of some electro-dynamic machine, i.e. for obtaining motive power. What is the chief obstacle to its practical employment?

17. What is the chief cause of the retardation of signals transmitted through a submarine cable?

18. Explain the action of electricity on the nerve and muscle of a recently-killed animal.

LIGHT AND HEAT.
THREE HOURS ALLOWED.
GEOMETRICAL OPTICS.

1. Enunciate the law of the reflection of light at the polished surface of a body, and find the position of the

image of a luminous point which is situated in front of a plane mirror. Apply the result just found to determine the *form* and *position* of the image of an object placed before a plane mirror, and *trace* the visual pencil by which the eye, in a given position, sees any given point in the object.

2. Find the *form* and *position* of the image of a distant object produced by a small *concave spherical* mirror. Describe the *Newtonian* reflecting telescope, and show how to find its magnifying power.

3. Describe the structure of *the eye* as far as its optical properties are concerned, and show how *inverted images* of objects are formed upon the retina. Explain why the chief refraction takes place at the cornea, and show how the law of *visual direction* explains the *erect* appearance of objects through the means of the *inverted* image upon the retina.

4. Describe the construction of the *achromatic* object lens of a telescope, showing how the *achromatism* and *aplanatism* are produced. Find the *magnifying* power of the *astronomical* refracting telescope with a single eye-lens, and also the proper position of the eye-hole.

PHYSICAL OPTICS.

5. Explain what is meant by the *double refraction* of light in crystalline bodies, and give examples of *uniaxal* and *biaxal* crystals, stating why they have received these names.

6. Show how the property of *polarization* of a beam of light is exhibited by a rhomb of calc spar, and give Malus' rule for the brightness or intensity of each of the two polarized beams when analyzed in any given plane.

7. Explain what are meant by the interference colours of *thin plates*, and give examples where they are seen. Explain how *Newton's rings* are produced; and show how the values of the luminiferous interval for different colours of light were calculated from Newton's observations of them.

8. Describe some form of a polariscope by which the interference of *polarized light* exhibited by thin natural plates of mica and selenite can be witnessed. Give the explanation of the way in which the colours are produced, and explain how the *selenite designs* are constructed.

HEAT.

9. Describe the mode of constructing a *standard* mercurial thermometer, and find the formula for comparing the degrees on Fahrenheit's, the centrigrade and Reaumur's scales. When the temperatures on Fahrenheit's scale are 80 degrees and 16 degrees, what are the corresponding temperatures on the centrigrade and Reaumur's scales.

10. Explain what is meant by the *boiling point* of a liquid, and show how it varies with the height of the barometer. How are *the heights* of mountains ascertained by observing the temperature of boiling water on their summits?

11. State what is meant by the expansibility of bodies by increase of temperature. Explain how the different expansibilities of brass and steel are made available in the construction of the *compensation balance-wheel* of a chronometer. From what cause is such construction required?

12. Explain the principle and mode of action of the double-acting condensing steam-engine. What is meant by the term *using the steam expansively* in the working?

CHEMISTRY.

THREE HOURS ALLOWED.

No candidate is allowed to answer more than three questions in each division.

FIRST DIVISION.

1. What weight of oxygen is contained in one gramme of potassic chlorate?

2. What volume of hydrogen would be obtained if all the oxygen were taken away from a cubic foot of steam?

3. How could you prove that gunpowder is a mixture of sulphur, carbon, and nitre?

4. Describe by equations the action of hydrochloric acid on the following compounds—viz., chalk, iron, and manganese (peroxide).

5. What are the chief impurities in common spring water? How are they detected?

6. How would you ascertain whether a given mineral contains silica?

SECOND DIVISION.

1. A silver coin is suspected to contain a little gold; how would you ascertain whether gold is present in it?

2. What is the commonest ore of lead? How is the metal obtained?

3. What reasons are there for attributing to alumina the formula $Al_2 O_3$?

4. How is metallic zinc prepared? Give its characteristic reactions, and the formula for its crystallised sulphate.

5. How would you test for copper in a mixture containing other metals?

6. Name and describe the chief ores of iron.

THIRD DIVISION.

1. How would you ascertain whether a given sample of water contains organic matter in solution.

2. What are the chief proximate constituents of wheat flour? How would you separate them?

3. How would you ascertain the proportion of alcohol in a given sample of wine?

4. Describe and explain the process of etherification.

5. How can aniline be made from a benzoate?

6. How is acetone prepared? Give its empyrical and its rational formula, and adduce proofs of the latter.

MINING AND METALLURGY.

THREE HOURS ALLOWED.

Six questions to be answered.

1. Name the various machines employed for grinding the ores of copper, lead, tin, and silver.

2. Which are the most important silver-producing countries in the world?

3. Describe Pattinson's process for desilvering lead.

4. How do you estimate the amount of gold contained in a given weight of auriferous quartz?

5. Describe the metallurgical treatment of zinc ores by what is called the Belgian process.

6. Describe the characteristic peculiarities of the Cornish pumping-engine.

7. What is the geological age of the gold-producing rocks of California?

8. What process would you commercially employ in order to ascertain the produce of copper of an ore containing less than 3 per cent of that metal?

9. Under what conditions is stream tin usually found, and wherein does it differ from tin ore obtained from mineral veins?

10. Describe the process of reducing poor copper ores to the state of matt, or regulus, by roasting in the open air, and fusing in a blast furnace.

11. How would you estimate the amount of tin contained in a specimen of gun-metal?

12. Describe the process of making iron by the Catalan forge.

BOTANY.

THREE HOURS ALLOWED.

The candidate is expected to answer correctly three questions in Section I. and six questions in Sections II. and III., including descriptions of at least two of the fresh specimens. Nos. 8, 9, and 10 each stand for an answer.

SECTION I.—STRUCTURE AND PHYSIOLOGY.

1. Define the following, and comment upon each as required:—

Radicle. What is meant by the terms superior and inferior applied to it?
Zoospores. What is their function?
Drupe. Give four examples.

2. A potato is planted weighing four ounces. In six months the produce of the tuber weighs, say four times as much. Whence is the addition in weight derived? And of what proximate and ultimate elements does it consist?

3. Explain the mode of growth of the bark of trees and the general characters which distinguish that of the Beech, Birch, and Elm respectively.

4. To what is the green colour of leaves due? In what functional contrast do the green organs stand to those of other colours?

5. What are Stomates? Where do they occur?

6. What are Seeds? Describe the structure of the seeds of the Hawthorn and Wheat.

SECTION II.—SYSTEMATIC AND ECONOMIC BOTANY.

1. Which Natural Orders furnish the following products? State the part of the plant affording each:—

Gum Arabic, Sago, Olive Oil, Indigo, Capers, Opium, Tamarinds.

2. State the distinctive characters of the three principal Orders of Vascular Cryptogams.

3. Describe the principal modifications of the fruit in British Cruciferæ.

4. Enumerate all indigenous British Coniferæ, and state how they differ.

5. Distinguish Chenopodiaceæ from Polygonaceæ.

6. What is meant by a Natural System of classification?

7. Name the Natural Orders to which the three plants marked A, B, and C respectively belong, with reasons for your opinion.

SECTION III.—DESCRIPTIVE BOTANY.

8, 9, and 10. Describe the three plants marked A, B, and C, noticing the various organs in their proper sequence.

FLORICULTURE.

THREE HOURS ALLOWED.

1. Name for each month in the year three popular flowers, which can be had in profusion for decorative purposes, indicating whether they come into bloom naturally, or require to be forced.

2. Explain in detail the operation of planting a tree or shrub of moderate size, indicating all the more essential points to be attended to.

3. Mention all the cultivated species of Tacsonia known to you, and show how they may be popularly distinguished.

4. How would you tell a Pteris from a Polypodium, and how a Polypodium from an Aspidium?

5. Cheilanthes, Trichomanes, Gymnogramma, and Osmunda, are all Ferns. Would you consequently treat them all alike as to the supply of moisture afforded them? If not, explain what difference you would make.

6. In what condition of the sap would you perform the operation of pruning, and for what reason?

7. Name a score of the best modern bedding plants for colour, and the same number for producing foliage effects.

8. Name a good selection of Lawn Grasses, and state the proportions of each which should be sown to ensure a good turf, giving the quantities proper for sowing an acre.

9. Explain the principal differences of treatment respectively conducive to foliiferous and floriferous growth in plants entirely under the control of the cultivator.

10. State what you believe to be the chief merits and defects of the different kinds of hot-water boilers known to you.

11. In hybridising plants, has any general result as to the influence of the male and female parents respectively been observed, and if so, what is it?

12. Explain the general features of the treatment required by the following subjects respectively:—Ferns, Orchids, Cacti, Heaths, Hardy Annuals, and Bedding Plants.

FRUIT AND VEGETABLE CULTURE.

THREE HOURS ALLOWED.

1. When is grafting to be performed? Describe the process in detail.

2. When is budding to be performed? Describe the process, and state the condition in which the scion and stock must be for the operation to be successfully performed.

3. What produces rust in grapes, and how would you prevent it?

4. How would you distinguish the fruit of Elruge nectarine from that of Violette hâtive, and is there any characteristic by which the trees may be distinguished?

5. How would you distinguish the fruit of Roman nectarine from that of Pitmaston orange, and what characteristic distinguishes the trees?

6. Describe the mode of forcing strawberries, the preparation of the plants, the subsequent culture, and the varieties best adapted for the purpose.

7. Give as complete a list as you can of the plants grown as salads, distinguishing those for summer and those for winter use.

8. Describe the culture and management of the cucumber by training it over a trellis, so as to furnish a supply of fruit during the months of December and January.

9. How would you keep up a supply of coleworts and cabbages by merely two sowings in the year? Give the details of the process.

10. How would you distinguish salsify from scorzonera when growing? and how by the roots?

11. Describe the process of forcing the mushroom.

12. What soil would you select as best for a crop of broccoli, what for carrots, and what for onions?

13. What influence has light on plants?

14. How do plants absorb nutrition?

ANIMAL PHYSIOLOGY.

THREE HOURS ALLOWED.

Candidates may answer any four of these six questions, but only four. If any paper is found to contain answers to more than four questions, marks will be given for the first four only of those answers.

1. State the properties of gastric juice, and its effect upon food. Briefly describe the various circumstances which affect the quantity and quality of gastric juice, explaining the manner in which they act.

2. Explain the structure and the use of the arteries.

3. Give the composition of urine, indicating the nature of its constituents. What purpose in the economy does the secretion of urine serve?

4. Compare the eye and the ear, both as regards structure and function.

5. What are the essential differences between the work done by (a) a simple nerve; (b) the spinal cord; (c) the brain?

6. Give a brief sketch of the structure and functions of the larynx.

DOMESTIC ECONOMY.

THREE HOURS ALLOWED.

1. Describe the effects of roasting, baking, broiling, frying, boiling, and stewing as regards economy, and

the comparative suitability of these processes in the preparation of meat for food.

2. What are the most important substances composing the flesh of animals ?

3. Prepare a table of diet for a poor family. Explain the advantages of the various substances which you would use, having regard to economy, and the health and strength of the members of the family.

4. Give a full account of the properties and uses of milk.

5. Mention some of the common condiments, their special uses, and the effects they have when taken into the animal system.

6. What species of fungi are eatable, and mention some of the indications by which the wholesomeness or unwholesomeness of this class of vegetables may be known ?

7. What are the usual adulterations in milk, ground pepper and coffee, bread, and how may they be detected ?

8. What means are commonly employed for purifying water ? How far are they severally effectual ? What are the effects of the impurities in water in a sanitary or economical point of view ?

9. Mention the chief points for consideration in the selection of a house in a town, to contain eight beds, as respects the site, design, aspect, and materials of construction.

10. Mention similar details respecting the selection of a house in the country.

11. Explain the process of respiration, and the effects of bad ventilation upon the constitution.

12. Mention the several advantages of a small fire in a sick room, even in warm weather.

13. State what ought to be done, and what ought specially to be avoided, in the treatment of a frozen person or a frost-bitten part.

14. State what ought to be done, and what ought specially to be avoided, in the treatment of scalds or burns.

15. In a case of severe bleeding from a wound in the leg or thigh, state what should be done in the absence of a medical man.

16. State the causes that predispose to typhus fever and cholera.

17. Give rules for the general management of a sick room, as respects air, light, and warmth, furniture, cleaning, quiet, food, and drink.

18. Describe the different modes in which small savings may be turned to a good account.

19. What is the expense of carpeting a room 28 feet long, and 19 feet wide, with carpet three-quarters of a yard wide, at 5s. 9d. a yard?

20. I owe a tradesman £528 9s., which will be due to him four months hence, at $4\frac{7}{8}$ per cent. interest. What should I save if I paid the debt immediately ?

POLITICAL AND SOCIAL ECONOMY.

THREE HOURS ALLOWED.

1. How are guardians appointed, and what are their rights and duties ?

2. What are the rights of a husband to the property of his wife, with a distinction between that which is personal and that which is real ?

3. What is the law as to apprentices, and what changes have at different times been made in it.

4. What was the conflict between the law of England and that of the civilians and canonists as to the legitimacy of *antenati* ?

5. Describe the "Act of Settlement."

6. What are the privileges of Parliament, and what is their foundation ?

7. What is the English law of naturalisation, and what inconveniences have arisen or may arise from it ?

8. What are letters of marque and reprisals, and under what circumstances may they be granted ?

Questions from Professor Fawcett's Manual for those who aspire to a first-class certificate.

1. Of what elements does profit consist, and on what does the rate of profit depend ?

2. What are the restrictions put by trades' unions on the employment of apprentices ? What can be said against such restrictions, and what if any thing for them ?

3. Describe the different forms of co-operation; the merits and defects of each.

4. In what way do you divide commodities in reference to the circumstances that determine their price ?

5. Describe the different forms and the different purposes of credit. In what case is credit beneficial, and in what is it otherwise ?

6. What do you understand by equality of taxation, and how is it best secured ?

GEOGRAPHY.

THREE HOURS ALLOWED.

1. Write a brief description of the physical features of either England, Scotland, or Ireland, with reference especially to the distribution of the high grounds and the direction of the river-basins.

2. Specify the principal seats of manufacturing industry in England and Scotland, naming the more considerable towns within each, and the description of manufacture carried on.

3. What conditions of outline, climate, and physical geography in general, distinguish Europe from other parts of the globe ?

4. Draw (from memory) an outline map of either France, Spain, Italy, or Russia. Show on it the direction of the high grounds, the courses of the principal rivers, and a few of the larger towns.

5. Give some account of the natural features of Germany, as a whole—its mountains, river-basins, &c.—without reference to its political divisions.

6. What are the main conditions in the present political division of Germany ? What changes in this respect were consequent on the war of 1866 ? What number of German States are there at the present time, and which is most powerful amongst them ?

7. In which of the German States are situated, respectively, Magdeburg, Breslau, Gottingen, Leipzig, Nuremberg, Carlsruhe, Heidelberg, Weimar, Darmstadt, Rostock, Kiel, and Frankfort-on-the-Main? Describe briefly the locality of each.

8. Name twelve of the largest cities of the United States; specify which amongst them are on the Atlantic seaboard, which within the valley of the Mississippi, which beyond the Rocky Mountains.

9. Describe briefly the physical features of the Australian continent as a whole. What colonies does it now include ?

10. Draw (from memory) a map of one of the Australian colonies, or of New Zealand.

11. Give some account of the currents of the Atlantic Ocean, and particularly of the Gulf stream. How are the currents accounted for ?

12. To what regions are the following respectively indigenous:—coffee, cocoa, sugar-cane, clove and nutmeg, cassava (mandioca), tobacco, potatoe, maize, yam, bread-fruit, date-palm, cocoa-nut palm ? Give some instances of the changes effected by human agency in the distribution of these or other productions of the Old and New Worlds respectively.

ENGLISH HISTORY.

THREE HOURS ALLOWED.

GENERAL QUESTIONS.

1. Give an account of the social condition of the Britons at the time when this island fell under the notice of Cæsar ; and show what improvements were introduced at its conquest by the Romans.

2. How long did the Roman occupation last ? State briefly some of the main events which happened during that interval.

3. Write a brief account of the life of Alfred, with the dates; and state what laws and institutions have been attributed to this king.

4. What were the judicial methods in use among the Anglo-Saxons for detecting and punishing civil offences ?

5. Give the dates of the Norman Conquest, and the succession of the different Norman kings. Show their relations to each other.

6. What was the subject of dispute between the Norman kings and the Archbishops of Canterbury, and between Henry II. and the Archbishop Thomas à Becket ?

7. Give the dates of the following events :—The accession of John—Magna Charta—The Barons' wars—The battle of Lewes—Meeting of the first House of Commons —Conquest of Ireland—Reduction of Wales—Battle of Bannockburn.

8. When did the Plantagenet dynasty commence ? When did it close ? Mention the names and give the dates of the accession of the most eminent kings of this line.

9. What constitutional advantages were gained under the Plantagenet and Lancastrian kings ?

10. How were the claims of the contending factions reconciled by the accession of Henry VII. ?

11. Give the dates of the accession of Henry VIII.— The separation of this country from Rome—The death of Cardinal Wolsey—The accession of Edward VI.—Of Elizabeth—The Spanish Armada—The establishment of the Court of High Commission.

12. What was the purpose of the Hampton Court Conference ?

13. By what ministers were the counsels of Charles I. successively directed ? What were the distinct aims of each, and what the final result ?

14. Place these names under the reigns to which they belong :—Lord Bacon, Locke, Burke, Dryden, Spenser, Robert Earl of Essex, the two Pitts, Sir Isaac Newton, Sir Humphrey Davy.

SPECIAL.

(a.) When did the Long Parliament commence and end ? How many parliaments were summoned by Charles II. ? What were the chief questions in debate between the king and the House of Commons ?

(b.) What circumstances tended to foment that jealousy of the Roman Catholics which broke out in the reign of Charles II. ? In what actions did that jealousy display itself ?

(c.) Give an account of any one of the following statesmen :—The first Earl of Shaftesbury ; Edward Hyde, Lord Clarendon ; Lord William Russell.

ENGLISH LITERATURE.

THREE HOURS ALLOWED FOR THE TWO AUTHORS SELECTED BY THE CANDIDATE.

CHAUCER.

(The Prologue.—The Knight's Tale.)

(a.) Lo the ook, that hath so long norisschyng
    Fro tyme that it gynneth first to spring,
    And hath so long a lyf, as we may see,
    Yet atte laste wasted is the tree.

(b.) Thus ryt this duk, thus ryt this conquerour,
    And in his oost of chevalrie the flour,
    Till that he came to Thebes, and alighte
    Fair in a feeld wher as he thoughte to fighte.

(c.) And sikurly sche was of gret disport,
    And ful plesant, and amyable of port,
    And peyned hire to counterfete cheere
    Of court, and ben estatlich of manere,
    And to ben holden digne of reverence.

(d.) The busy larke, messager of day,
    Salueth in hire song the morwe gray ;
    And firy Phebus ryseth up so bright,
    That al the orient laugheth of the light,
    And with his stremes dryeth in the greves
    The silver dropes, hongyng on the leeves.

(e.) To lyven in delite was al his wone,
    For he was Epicurius owne sone,
    That heeld opynyoun that pleyn delyt
    Was verraily felicite perfyt.

(f.) For whethur that he payde, or took by taille,
    Algate he waytede so in his acate,
    That he was ay biforn and in good state.

1. In what connection does each of the above passages occur ?—Explain every obsolete word and phrase.—Notice the words that require to be pronounced or accented differently from modern usage to meet the requirements of the verse.

2. What are the most important particulars in which Chaucer's English differs from our own ?

3. What do the following words mean ?—

orlogge	siththen	knarre
payen	sege	takel
sothely	sawceflem	undern
howpede	gery	stith

II.

4. Sketch the plan of the Canterbury Tales.

5. From what sources did Chaucer get many of the stories ?

6. Give some account of the character of pilgrimages in the time of Chaucer.

7. Who were Chaucer's most distinguished contemporaries ? Name some of their principal works.

8. On what occasions did Chaucer visit the Continent ?

SHAKSPERE.

("King Lear."—"King John."—"The Merchant of Venice.")

I.

(a.) A plague upon your epileptic visage !
    Smile you my speeches, as I were a fool ?
    Goose, if I had you upon Sarum-plain,
    I'd drive you cackling home to Camelot.

(b.) You have too much respect upon the world—
    They lose it that do buy it with much care.
    Believe me you are marvellously changed.

(c.)   Take physic, pomp ;
    Expose thyself to feel what wretches feel ;
    That thou mayst shake the superflux to them,
    And show the heavens more just.

(d.) A. James Gurney, wilt thou give us leave awhile ?
    B. Good leave, good Philip.
    A.   Philip ?—Sparrow !—James,
    There's toys abroad ; anon I'll tell thee more.

(e.) Thou almost makest me waver in my faith,
    To hold opinion with Pythagoras,
    That souls of animals infuse themselves
    Into the trunks of men.

(f.) Life is as tedious as a twice-told tale,
    Vexing the dull ear of a drowsy man ;
    And bitter shame hath spoiled the sweet world's taste,
    That it yields nought but shame and bitterness.

1. State the connection in which each of the above passages occurs, and the person by whom it is spoken ; explain every obscurity of expression or allusion ; notice every peculiar grammatical construction.

2. Explain the following words as they are used by Shakspere, and notice any peculiarities in their forms :—

counterfeit	schedule	pight
continent	jump	ghasted
bankrout	indigest	dullard
wis	importance	uncapable.

3. Explain the following passages :—

"How wildly then walks my estate in France !"

"We cannot hold mortality's strong hand."

"Beyond all manner of so much I love you."

II.

4. Sketch the plot of the fourth act of the Merchant of Venice.

5. Describe the character of Shylock.

6. Give an account of the fool in King Lear.

7. From what sources has Shakspere mainly taken the plots of these three plays ? Which are the chief particulars in which he has deviated from the facts of history in King John ?

8. What do you know of the early editions of Shakspere's plays ?

BACON.
(The Essays.)
I.

1. Give the substance of the essay " Of Unity in Religion.

2. How does Bacon prove and illustrate the following statements ?—

(a) " Revenge is a kind of Wild Justice."

(b) " Prosperity is the blessing of the Old Testament: Adversity is the blessing of the New."

(c) " Those who are first raised to Nobility are commonly more Virtuous but less Innocent than their Descendants."

3. Explain the following passages, and state from whom they are quoted by Bacon.

" (a) " The Schoolmen were like Astronomers, which did feign Eccentricks and Epicycles, and such Engines of Orbs, to save the Phenomena ; though they knew there were no such Things."

(b) " If it be well weighed, To say that a man lieth, is as much as to say as that he is brave towards God, and a Coward towards Men."

4. Explain the allusions in these passages :—

(a) " Nay you shall see a Bold Fellow many times do Mahomet's Miracle."

(b) " The part of Epimetheus might well become Prometheus, in the case of Discontentments."

5. Illustrate this statement by historical instances:—

"The Principal Thing that hath been the Destruction of most Plantations hath been the Base and Hasty drawing of Profit in the first Years."

6. Sketch the argument written of the essay " Of Usury," or that " Of Friendship."

7. Explain these words as they are used by Bacon:—

damosell.	civility.	defatigation.
conceit.	estivation.	scantling.
battaille.	proyning.	catchpole.
staddles.	moile.	plash.

II.

8. What do you know of the first publication of Bacon's Essays ?

9. Give some account of the *Novum Organon*.

10. Sketch the character of Lord Bacon as an essayist.

CRAIK.
(Outlines of the History of the English Language.)

1. Give some account of the tribes of Gothic race who settled in Britain, and brought with them the language which forms the basis of our present English.

2. What traces are there in our language of a Celtic element ?

3. Give instances of names of places which bear witness to the existence of different races amongst the inhabitants of Britain in former times.

4. To what class do those English words chiefly belong which have been taken immediately from the Latin ? Give examples.

5. Illustrate, by examples taken from words in common use, the relative positions of the Norman and the Saxon races when the language was in the course of formation.

6. What are some of the most important points of difference between our present English and the Saxon of King Alfred's time ?

7. What are the stages of progress into which the history of the language is commonly divided from the time of Alfred to the present ? Name some of the chief writers belonging to each stage.

8. Turn the following passage into modern English :—

"Trew king, that sittes in trone,
Unto the I tell my tale,
And unto the I bid a bone
For thou art bute of all my bale :
Als thou made midelerd and mone,
And bestes and fowles great and smale,
Unto me send thi socore sone,
And dresce my dedes in this dale."

9. Give an account of the following words :—

minister	porch	basket
saint	monastery	parsley
preacher	street	cloister
bishop	chester	bother

10. Explain these terms:—Limes Saxonicus, Indo-European, Romance, Mœso-Gothic, Langue d'Oyl, Danelagh.

LOGIC AND MENTAL SCIENCE.
THREE HOURS ALLOWED.
LOGIC OF INDUCTION.
Mill's Logic.

1. Explain the difference between deductive and inductive reasoning, giving an example of each.

2. What is the ground on which all inductions are fundamentally based ?

3. Is it an adequate explanation of causation to term it an *invariable sequence ?* If not, why not ?

4. What is the difference between observation and experiment ? Wherein consists the special value of the latter ?

5. Mill enumerates four methods of experimental inquiry. Explain the *two first*, with an example of each.

6. What is meant by the *explanation* of any law of nature ?

7. How do you distinguish between a legitimate and an illegitimate hypothesis ?

8. What is analogy ? What is its special use in scientific researches.

MORAL PHILOSOPHY.
Stewart's Outlines.

1. Show how mental philosophy shared in the general reformation of the method of philosophical research introduced by Bacon.

2. Give Stewart's classification of the active powers of man.

3. Distinguish between appetite, desire, and affection.

4. What reason have we to believe that the moral faculty is an original principle of our nature ?

5. What mental affections are we conscious of in contemplating a good or bad action performed by another ?

6. What is Cudworth's and what Hutcheson's theory of the manner in which we become cognisant of moral distinctions ?

7. By what line of argument does Stewart propose to prove the existence of a God ?

8. Enumerate and explain two or three of the most important theories on the ground of morals.

9. What is Utilitarianism ? What objections may be most obviously raised against it ?

MENTAL PHILOSOPHY.
Hamilton.

1. What is meant by the presentative faculty ? How is Hamilton's doctrine on this faculty distinguished from those of other celebrated philosophical writers ?

2. Distinguish accurately between sensation proper and perception proper.

3. Give the reasons which have been urged to show, 1st, that *touch*, and 2nd, that *sight*, is the origin of our ideas of extension.

4. What is meant by the conservative faculty ? Account for the fact of our retaining ideas and impressions without being conscious of them.

5. What is the reproductive faculty ? Mention the principal laws of reproduction.

6. What does Hamilton mean by the representative faculty ? Why is it so called ? What phenomena are classified by Hamilton under it ?

7. Distinguish carefully between the elaborative and regulative faculty. What are their respective functions ?

FORMAL LOGIC.

1. What are concepts ? Analyse the process by which they are formed in the mind.

2. Give the rules of a good division, and examples of false ones.

3. What is meant in logic by *definition ?* Show what sort of terms admit of definition, and what sort do not, and why ?

4. What are the predicables, and what the predicaments ? What is the purport of each of these classifications ?

5. What is meant by the quantity, and what by the quality of a proposition ? What symbols are used to designate them ?

6. How many ways are there of " converting " a proposition ? Give an example of each.

7. What are contraries, subcontraries, and contradictories ? Give an example of each.

8. Explain what is meant by a syllogism, what by its mood, and what by its figure.

9. How many figures are there ? Give the special rules of each, and justify them.

10. In what mood and figure are the following syllogisms drawn :—

No vicious habit ought to be indulged.
Some vicious habits promote a temporary interest.
Some things which promote a temporary interest ought not to be indulged.
Whatever requires to be known in order to salvation is revealed in the Scriptures.
Whatever requires to be known in order to our salvation ought to be diligently studied.
Some things which ought to be diligently studied are revealed in the Scriptures.

11. Give examples of the Ignoratio clenchi, Petitio principii, and Fallacia consequentis.

LATIN AND ROMAN HISTORY.
SECTION I.

Translate :—

Sic ubi deseruit madidos septemfluus agros
Nilus, et antiquo sua flumina reddidit alveo,
Aetherioque recens exarsit sidere limus,
Plurima cultores versis animalia glebis
Inveniunt, et in his quaedam modo coepta sub ipsum
Nascendi spatium, quaedam imperfecta suisque
Trunca vident numeris, et eodem in corpore saepe
Altera pars vivit, rudis est pars altera tellus.
Quippe ubi temperiem sumpsere humorque calorque,
Concipiunt, et ab his oriuntur cuncta duobus.
Cumque sit ignis aquae pugnax, vapor humidus omnes
Res creat, et discors concordia fetibus apta est.
Ergo ubi diluvio tellus lutulenta recenti
Solibus aetheriis altoque recanduit aestu,

Edidit innumeras species, partimque figuras
Rettulit antiquas, partim nova monstra creavit.
Illa quidem nollet, sed te quoque, maxime Python,
Tum genuit, populisque novis, incognite serpens,
Terror eras ; tantum spatii de monte tenebas.

1. Parse fully, giving both accidence and syntax, the words deseruit, nascendi, numeris, aquae, fetibus, nollet.

2. Give the present and perfect tenses indicative and the supines of the verbs exarsit, concipiunt, rettulit, tenebas.

SECTION II.

Translate :—

Redeuntem colle Lycaeo
Pan videt hanc, pinuque caput praecinctus acuta
Talia verba refert—Restabat verba referre,
Et precibus spretis fugisse per avia nympham,
Donec arenosi placidum Ladonis ad amnem
Venerit ; hic illi cursum impedientibus undis,
Ut se mutarent, liquidas orasse sorores :
Panaque cum prensam sibi iam Syringa putaret,
Corpore pro nymphae calamos tenuisse palustres :
Dumque ibi suspirat, motos in arundine ventos
Effecisse sonum tenuem similemque querenti.
Arte nova vocisque deum dulcedine captum
" Hoc mihi concilium tecum " dixisse " manebit."
Atque ita disparibus calamis compagine cerae
Inter se iunctis nomen tenuisse puellae.
Talia dicturus vidit Cyllenius omnes
Succubuisse oculos, adopertaque lumina somno.

1. Parse fully, giving both accidence and syntax, the words caput, precibus, illi, querenti, compagine, succuquisse.

2. Turn the following four lines into the *oratio recta :*—

Dumque ibi suspirat, motos in arundine ventos
Effecisse sonum tenuem, similemque querenti ;
Arte novâ vocisque Deum dulcedine captum,
Hoc mihi concilium tecum, dixisse, manebit.

SECTION III.

Translate :—

Ego autem, etsi vereor laudare praesentem, iudico tamen de re obscura atque difficili a te dictum esse dilucide, neque sententiis solum copiose, sed verbis etiam ornatius quam solent vestri. Zenonem, quem Philo noster coryphaeum appellare Epicureorum solebat, quum Athenis essem, audiebam frequenter et quidem ipso auctore Philone, credo, ut facilius iudicarem quam illa bene refellerentur, quum a principe Epicureorum accepissem quem ad modum dicerentur. Non igitur ille, ut plerique, sed isto modo, ut tu, distincte, graviter, ornate. Sed quod in illo mihi usu saepe venit, idem modo, quum te audirem, accidebat, ut moleste ferrem tantum ingenium—bona venia me audies—in tam leves, ne dicam in tam ineptas, sententias incidisse. Nec ego nunc ipse aliquid adferam melius. Ut enim modo dixi, omnibus fere in rebus et maxime in physicis quid non sit citius quam quid sit dixerim.

1. Parse fully, giving both accidence and syntax, the words sententiis, auctore, refellerentur, veniâ, incidisse, sit.

2. Give the present and perfect tenses indicative and the supines of the verbs accepissem, dicerentur, accidebat, adferam.

SECTION IV.

Translate :—

Etenim si semel, Vellei, suscipimus genus hoc argumenti, attende quo serpat. Tu enim sumebas nisi in hominis figura rationem inesse non posse : sumet alius nisi in terrestri, nisi in eo, qui natus sit, nisi in eo, qui adoleverit, nisi in eo, qui didicerit, nisi in eo, qui ex animo constet et corpore caduco et infirmo, postremo nisi in homine atque mortali. Quod si in omnibus his rebus obsistis, quid est quod te una forma non turbet ? His enim omnibus, quae proposui, adjunctis in homine rationem esse et mentem videbas. Quibus detractis deum

PART II.

Candidates for a second-class certificate are to answer questions 9, 10, and 11 in Part I., together with those in Part II., and to translate the English extract and idiomatic expressions which follow.

Grammar.

1. In the first sentence of the French extract in Part I. there occurs this apparent anomaly—that whilst in " la première cause qui *ait* rendu, &c.," the verb is construed in the subjunctive mood, the indicative mood is used in " le premier des faits intellectuels qui *ont* amené, &c." Can you explain this difference ?

2. When are you to translate "it is" by " *ce* sont," and not by " c'est " ? Give examples.

3. When should " it is " immediately before an adjective be rendered by " il est," and when by " c'est "?

4. Give, with suitable examples, any three important rules on the syntax of personal or possessive pronouns in French.

5. Distinguish between "les César et les Napoléon," "les Pitt et les Cobourg," and "les Césars et les Napoléons," "les Pitts et les Cobourgs."

6. Explain the difference of meaning between " Il se plaint qu'on l'a volé," and "Il se plaint qu'on l'ait volé." Distinguish also between " Cela impose " and " Cela en impose," between " participer à " and " participer de,"—and between " servir à rien " and " servir de rien."

Translation.

It is an extraordinary thing that man, with a mind so wonderful that there is nothing to compare with it elsewhere in the known creation, should leave it to run wild in respect of its highest elements and qualities. He has a power of comparison and judgment, by which his final resolves, and all those acts of his material system which distinguish him from the brutes, are guided : shall he omit to educate and improve them when education can do much ? Is it towards the very principles and privileges that distinguish him above other creatures he should feel indifference ? Because the education is internal, it is not the less needful; nor is it more the duty of a man that he should cause his child to be taught than that he should teach himself. Indolence may tempt him to neglect the self-examination and experience which form his school, and weariness may induce the evasion of the necessary practices ; but surely a thought of the prize should suffice to stimulate him to the requisite exertion; and to those who reflect upon the many hours and days devoted by a lover of sweet sounds to gain a moderate facility upon a mere mechanical instrument, it ought to bring a blush of shame, if they feel convicted of neglecting the beautiful living instrument wherein play all the powers of the mind.— FARADAY.

Idioms.

1. Il a pris fait et cause pour moi ; sans quoi on m'aurait donné du fil à retordre.
2. Nous avons eu maille à partir ensemble.
3. Il est resté sur le carreau.
4. Je suis au bout de mon latin.
5. Je n'y suis pour rien.
6. Vous n'y êtes pas à beaucoup près.
7. Vous trouverez chaussure à votre pied.
8. Il mesure toujours les autres à son aune.
9. Partageons le différend.
10. On lui a monté la tête.
11. Ne vous faites donc pas tant tirer l'oreille.
12. Il va toujours son petit bonhomme de chemin.

PART III.

Candidates for a first-class certificate are expected to translate the above idioms and English extract, and to answer in French the grammatical questions 2, 3, and 6 in Part II., as also the following :—

Literature.

1. State what you know of either Marot or Malherbe.

2. Trace the Italian influence through the literature of France during the reigns of the three last Valois.

3. What was the *Pléiade ?* And what do you know of the *Satire Ménippée ?*

History.

Sketch the character of Charlemagne as a legislator.

GERMAN.

THREE HOURS ALLOWED.

Each candidate is expected to translate one of the extracts in Section I., to answer four of the questions in Section II., and to turn into German twelve of the sentences given in Section III. Candidates for a First Class must translate two pieces in Section I., one prose, the other poetry ; answer (e) and (f) of Section II. ; render into German 17-20, inclusive, of Section III., and work out the whole of Section IV. :—

SECTION I.

1. Wilhelm war drei und zwanzig Jahre alt, als Karl die Regierung niederlegte, und hatte schon zwei öffentliche Beweise der höchsten Achtung von ihm erhalten. Ihm übertrug er, mit Ausschliessung aller Groszen seines Hofes, das ehrenvolle Amt, seinem Bruder Ferdinand die Kaiserkrone zu überbringen. Als der Herzog von Savoyen, der die kaiserliche Armee in den Niederlanden commandirte, von seinen eigenen Landesangelegenheiten nach Italien abgerufen ward, vertraute der Kaiser ihm den Oberbefehl über diese Truppen an, gegen die Vorstellungen seines ganzen Kriegsraths, denen es allzu gewagt schien, den erfahrnen französischen Feldherren einen Jüngling entgegen zu setzen. Abwesend und von Niemand empfohlen zog ihn der Monarch der lorbeervollen Schaar seiner Helden vor, und der Ausgang liesz ihn seine Wahl nicht bereuen.

Die vorzügliche Gunst, in welcher dieser Prinz bei dem Vater gestanden hatte, wäre allein schon ein wichtiger Grund gewesen, ihn von dem Vertrauen seines Sohnes auszuschlieszen. Philipp, scheint es, hatte es sich zum Gesetz gemacht, den spanischen Adel an dem niederländischen wegen des Vorzugs zu rächen, wodurch Karl der Fünfte diesen letztern stets unterschieden hatte. Aber wichtiger waren die geheimen Beweggründe, die ihn von dem Prinzen entfernten.

2. Nicht Stimmenmehrheit ist des Rechtes Probe :
England ist nicht die Welt, dein Parlament
Nicht der Verein der menschlichen Geschlechter.
Dies heut'ge England ist das künft'ge nicht,
Wie's das vergangne nicht mehr ist—Wie sich
Die Neigung anders wendet, also steigt
Und fällt des Urtheils wandelbare Woge.
Sag' nicht, du müssest der Nothwendigkeit
Gehorchen und dem Dringen deines Volks
Sobald du willst, in jedem Augenblick
Kannst du erproben, dasz dein Wille frei ist :
Versuch's ! Erkläre, dasz du Blut verabscheust,
Der Schwester Leben willst gerettet sehn,
Zeig' denen, die dir anders rathen wollen,
Die Wahrheit deines königlichen Zorns :
Schnell wirst du die Nothwendigkeit verschwinden
Und Recht in Unrecht sich verwandeln sehn.
Du selbst muszt richten, du allein. Du kannst dich
Auf dieses unstet schwanke Rohr nicht lehnen.
Der eignen Milde folge du getrost.
Nicht Strenge legte Gott ins weiche Herz
Des Weibes—und die Stifter dieses Reichs,
Die auch dem Weib die Herrscherzügel gaben,
Sie zeigten an, dasz, Strenge nicht die Tugend
Der Könige soll seyn in diesem Lande.

3. Als unerfahrner Knabe kam ich her,
In einem Augenblick, da Fest auf Fest
Ferrara zu dem Mittelpunkt der Ehre
Zu machen schien. O ! welcher Anblick war's !
Den weiten Platz, auf dem in ihrem Glanze
Gewandte Tapferkeit sich zeigen sollte,
Umschlosz ein Kreis, wie ihn die Sonne nicht

So bald zum zweitenmal bescheinen wird.
Es saszen hier gedrängt die schönsten Frauen,
Gedrängt die ersten Männer unsrer Zeit.
Erstaunt durchlief der Blick die edle Menge ;
Man rief : Sie alle hat das Vaterland,
Das Eine, schmale, meerumgebne Land,
Hierher geschickt.   Zusammen bilden sie
Das herrlichste Gericht, das über Ehre,
Verdienst und Tugend je entschieden hat.
Gehst du sie einzeln durch, du findest keinen,
Der seines Nachbarn sich zu schämen brauche !—
Und dann eröffneten die Schranken sich :
Da stampften Pferde, glänzten Helm' und Schilde,
Da drängten sich die Knappen, da erklang
Trompetenschall, und Lanzen krachten splitternd,
Getroffen tönten Helm' und Schilde, Staub,
Auf einen Augenblick, umhüllte wirbelnd
Des Siegers Ehre, des Besiegten Schmach.
O, lasz mich einen Vorhang vor das ganze,
Mir allzuhelle Schauspiel ziehen, dasz
In diesem schönen Augenblicke mir
Mein Unwerth nicht zu heftig fühlbar werde !

4. Philipp von Hessen wurde am 19 Juli in Halle vor den Kaiser geführt, der auf einem Throne sasz, umgeben von vielen deutschen, spanischen, und italienischen Groszen.   Mit niedergeschlagenem Blicke kniete der Landgraf am Fusze des Thrones nieder und sein Kanzler Günthe-rode, hinter ihm knieend, las die Abbitte an den Kaiser ab.   Sie war in sehr demüthigen Ausdrücken abgefaszt und ein Augenzeuge erzählt, es habe sich in der Verwir-rung und Beschämung, die den Landgrafen in solcher Lage, vor solcher Versammlung, ergriff, auf seinem Ge-sichte ein Lächeln gezeigt, gleichsam als unbewuszte Hülfe seiner Natur gegen das Gefühl der Schmach. Aber dem Kaiser entging seine Miene nicht ; drohend hob er seinen Finger auf und sprach in seiner nieder-ländischen Mundart, denn er redete das Deutsche schlecht : —" Wel, ich sal juw lachen lehren."   Dann las des Kaisers Kanzler, Dr. Seld, die Antwort ; " Obwohl der Landgraf wie er selbst bekenne, die schwerste Strafe ver-dient habe, so wolle dennoch der Kaiser, aus angeborner Milde und in Betracht der für ihn eingelegten Fürbitten, Gnade vor Recht ergehen lassen, ihn von der Acht erle-digen und ihm das Leben, welches er verwirkt habe, schenken."   Nach der Ablesung dieser Antwort wollte sich der Landgraf, als ein freier Fürst wieder erheben, und als der Kaiser ihm keinen Wink dazu gab, auch ihm den deutschen Handschlag der Versöhnung versagte, stand er von selber auf und trat ab.

Section II.—Grammar and Idioms.

(a.) Give the nominative singular with the definite article of the following plural substantives, and state the different meanings of the two forms of the plural :—*Bänder, Bande ; Läden, Laden ; Strausze, Sträusze ; Wörter, Worte ; Zolle, Zölle.*

(b.) Determine by rule the gender of—*Frühling, Silber, Schlüszel, Hoffnung, Herzogthum, Schlacht, Gabel, Mädchen, Stadtthor.*   Add to each the genitive singular and plural.

(c) Decline in every case, singular and plural, the German of—" Dear brother ; this good book : his new hat."

(d.) Conjugate the imperfect, perfect, and first future of *haben,* and *sein,* of *es friert mich,* and *es gebricht mir.*

(e.) State the imperfect, indicative, and subjunctive, and participle past of—*werfen, helfen, leiden, müszen,* and *wiszen.*

(f.) Express in German :—1. He has written to me that he will come.   2. That he will come, he has written to me.   3. Should he come, he must wait.   4. He must wait should he come.   Describe these clauses and their construction.

(g.) Das macht sich.
Das ist allerliebst.
Er hat sich schwer an ihr vergangen.
Er ist zuletzt ganz verkommen und verschollen.
Sie lebten in Saus und Braus.

Das steht ganz und gar bei Ihnen.
Er hat sich auf und davon gemacht.
Ach ! warum nicht gar.
Er hat sich umgebracht.
Bekümmere dich doch nicht um ungelegte Eier.
Er zieht immer den kürzeren.
Das hält gar nicht Stich.

Section III.

[The writing, either in English or German characters, must be thoroughly legible and distinct.]

1. How many sorts of roses have you in your garden ?
2. There are books which I never read.
3. At what o'clock do you go out in the morning ?
4. All that I have I have given you.
5. He would sit for hours and read the newspapers.
6. Would that I had never seen him !
7. We had succeeded in overcoming the difficulties.
8. Do you remember them and their cousins ?
9. One cannot always say what one will fail in.
10. Had I your knowledge, I would make good use of it.
11. Do you believe him to be honest and truthful ?
12. Please tell me what day of the month it is to-day.
13. If I were to take it all, I should not have enough.
14. They were praised for what they had done.
15. An ambassador has been sent to Turkey.
16. Who has been helped in his work ?
17. They went into a field, and laid themselves down on the grass.
18. He received five pounds a-week, and would not give two pounds and a-half to his poor old mother.
19. We got up at a quarter to six, and started punctu-ally at a quarter past seven.
20. We know that time is short, but none of us know how short.   We know that it will not go beyond a certain limit of years ; but none of us know how small the num-ber of years, or months, or days may be, for death is at work upon all ages.   The fever of a few days may hurry the likeliest of us all from this land of mortality. The cold of a few weeks may settle into some lingering but irrecoverable disease.   In one instant the blood of him who has the promise of many years may cease its circulation.   Accident may assail us.   A slight fall may precipitate us into eternity.   An exposure to rain may lay us on the bed of our last sickness, from which we are never more to rise.   A little spark may kindle the mid-night conflagration, which lays a house and its inhabitants in ashes.   A stroke of lightning may arrest the current of life in a twinkling.   A thousand dangers beset us on the slippery path of this world.

Section IV.

Questions in German History and Literature.

(*a.*) State some of the causes which led to the Reforma-tion in Germany.

(*b.*) Which are the dates of the Edicts of Worms and of Augsburg ?

(*c.*) What is the Confession of Augsburg, and by whom was it written ?

(*d.*) To which ancient epic poems can the "Niebe-lungenlied" and "Gudrun" be compared ; and who are the principal personages in these German poems ?

(*e.*) Which poems belong to the cycle of the Lombardian sagas ?

(*f.*) What is characteristic in them ?

German Essay.

Subject :—A visit to the Kensington Museum.

ITALIAN.

(THREE HOURS ALLOWED.)

I.

Candidates for a first-class certificate must translate the following passages (poetry and prose), and answer any grammatical questions annexed to them :—

Polifonte.   Chiaro mi narra
         E narra il ver, come tu mai giungessi
         A eccesso tanto.   Ove a sperar ti avanzi
         Più nulla omai, se ingenuo parli, spera.
Egisto. In altra guisa io non saprei: menzogna
         Del mio libero stato non è l'arte.—
         Io m'era al vecchio genitor di furto
         Sottratto, incauto! e già più mesi attorno
         Men giva errando per città diverse,
         Quand' oggi al fin qui m'avviava.   Un calle
         Stretto e solingo, che ai pedon dà via
         Lungo il Pamiso, con veloci piante
         Venìa calcando, impaziente molto
         Di porre il piè nella città, che mostra
         Mi fea da lungi vaga, e in un pomposa,
         D' alti palagi e di superbe torri.
         Quand' ecco, a me di contro altr' uom venirne,
         Più frettoloso assai: son d' uom che fugge
         I passi suoi; giovin l' aspetto; gli atti,
         Arroganti, assoluti: ei di lontano
         Con man mi accenna ch' io gli sgombri il passo.
         Angustissimo il loco, ad uno appena
         Adito dà: sul fiume alto scoscende
         Il mal sentier per una parte; l'altra,
         Irta d'ispidi dumi, assai fa schivo
         D'accostarvisi l'uomo.   Il modo spiacque
         A me, libero nato, uso soltanto
         D'obbedire alle leggi; a ceder solo
         Ai più vecchi di me: m'inoltro io quindi.
         Ei, con voce terribile; "Ritratti,
         O ch'io . . . ." mi grida. Ardo di sdegno allora:
         "Ritratti tu" gli replico.   Già presso
         Siam giunti: ei caccia un suo pugnal dal fianco,
         E su me corre: io non avea pugnale,
         Ma cor; lo aspetto di piè fermo; ei giunge;
         Io sottentro, il ricingo, e, in men che il dico,
         L'atterro: invan dibattesi; il conficco
         Con mie ginocchia al suol: sua destra afferro
         Con ambe mani; ei freme indarno, io salda
         Glie la rattengo, immota.   Quando ci troppo
         Debil si scorge al paragone, a finta
         Mercede viene; io il credo, il lascio; ei tosto
         A tradimento un colpo, qual qui vedi,
         Mi vibra; i panni squarcia; il colpo striscia;
         Lieve è il dolor, ma troppa l'ira: io cieco,
         Di man gli strappo il rio pugnal . . . . trafitto
         Nel sangue ei giace.
                                      (ALFIERI, Merope.)

GRAMMATICAL NOTES.

1. *Saprei:* Write the whole of the imperative of this verb.
2. *Eccesso tanto :* What is to be understood by *tanto* in this case ?
3. *Men :* Give the complete and separate form of these pronouns and their literal meaning.
4. *Giva :* What are the other two synonymous verbs of this ?
5. *Venìa :* Write the future of this verb.
6. *Fea :* What is the complete form of this ?
7. *Ei :* How could this pronoun be otherwise variously rendered ?
8. *Atterro :* Give the infinitive.
9. *Scorge :* Give the whole of the preterite tense and the participle past.
10. *Finta :* Give the infinitive.

II.

Io vi mando un presente, il quale, se non corrisponde agli obblighi che io ho con voi, è tale senza dubbio, quale ha potuto Niccolò Machiavelli mandarvi maggiore. Perchè in quello io ho espresso quanto io so, e quanto io ho imparato per una lunga pratica e continua lezione delle cose del mondo. E non potendo nè voi nè altri desiderare da me più, non vi potete dolere se io non vi ho donato più. Bene vi può increscere della povertà dello ingegno mio, quando siano queste mie narrazioni povere; e della fallacia del giudizio, quando io in molte

parti discorrendo m'inganni. Il che essendo, non so quale di noi si abbia ad esser meno obbligato all' altro, o io a voi che mi avete forzato a scrivere quello ch'io mai per me medesimo non avrei scritto, o voi a me, quando scrivendo non v' abbia soddisfatto. Pigliate adunque questo in quel modo che si pigliano tutte le cose degli amici, dove si considera più sempre l'intenzione di chi manda, che la qualità della cosa che è mandata. . . . . .
         (MACHIAVELLI, Dedication of his *Discorsi.*)

III.

Translate freely into Italian :—

There are two very natural propensities which we may distinguish in the most virtuous and liberal dispositions, the love of pleasure and the love of action. If the former be refined by art and learning, improved by the charms of social intercourse, and corrected by a just regard to economy, to health, and to reputation, it is productive of the greatest part of the happiness of private life.   The love of action is a principle of a much stronger and more doubtful nature.   It often leads to anger, to ambition, and to revenge; but when it is guided by the sense of propriety and benevolence, it becomes the parent of every virtue; and if those virtues are accompanied with equal abilities, a family, a state, or an empire, may be indebted for their safety and prosperity to the undaunted courage of a single man.   To the love of pleasure we may therefore ascribe most of the agreeable, to the love of action we may attribute most of the useful and respectable qualifications.   The character in which both the one and the other should be united and harmonised would seem to constitute the most perfect idea of human nature.   The insensible and inactive disposition, which should be supposed alike destitute of both, would be rejected, by the common consent of mankind, as utterly incapable of procuring any happiness to the individual or any public benefit to the world.
         GIBBON, *Decline and Fall of the Roman Empire.*)

IV.

FAMILIAR IDIOMS.
(To be rendered by their English equivalents.)
         Egli mi supera di gran lunga.
         Qui ci va dell'onore.
         Punger sul vivo.
         Adesso adesso capiterà colui.
         Se ci convenisse tornar da capo.
         Fai sempre lo svogliato.
         Un ritratto grande al vero.
         Il poveretto è spacciato.
         Si spaccia per amico nostro.
         Cotesta mercanzia non si spaccia.
         Non so se n'uscirete senza scapito.
         Buon pro vi faccia.

Candidates for second or third-class certificates must (1) translate into English the following extracts, and (2) answer the grammatical questions given below :—

Gioas.   Or che re sono,
         Sarà degno del trono anche il cor mio :
         Non sta il cor de' regnanti in man di Dio ?
Giojada.   Si; tel dissi, e mi piace
         Che il rammenti o Gioas; ma spesso ancora
         Cercando ad arte occasïon, t' esposi
         I doveri d'un re : questo è il momento
         Di ripeterli, o figlio.   Oggi d'un regno
         Dio ti fa don; ma del suo dono un giorno
         Ragion ti chiederà.   Tremane; e questo
         Durissimo giudizio, a cui t' esponi,
         Sempre in mente ti stia.   Comincia il regno
         Da te medesmo.   I desiderj tuoi
         Siano i primi vassalli, onde i soggetti
         Abbiano in chi commanda
         L'esempio d'ubbidir.   Sia quel che dèi,
         Non quel che puoi, dell' opre tue misura,
         Il publico procura
         Più che il tuo ben.   Fa che in te s'ami il padre,
         Non si tema il tiranno.   È de' regnanti

Mal sicuro custode
L' altrui timore, e non si svelle a forza
L' amore altrui. Premii dispensa e pene
Con esatta ragion. Tardo risolvi;
Sollecito eseguisci. E non fidarti
Di lingua adulatrice
Con vile assenso a lusingarti intesa;
Ma porta in ogni impresa
La prudenza per guida,
Per compagno il valore,
La giustizia sugli occhi, e Dio nel core.
  Tu compir così procura
    Quanto lice ad un mortale;
    E poi fidati alla cura
    Dell' eterno condottier.
  Con vigore al peso eguale
    L' alme Iddio conferma e regge,
    Che fra l' altre in terra elegge
    Le sue veci a sostener.
        (METASTASIO, Gioas, Re di Giuda.)

II.

Queste mie sono lettere d' uomo esule, il quale scrivendo per ozio agli amici suoi intorno alla nazione a cui rifuggì, ripensava pur tanto alla patria, che gli vennero fatti de' paragoni fra l'Inghilterra e l' Italia.

E tu pure guardane alcune per ozio; e non leggere un po' seriamente fuorchè la sola dettata con animo di pubblicarla ed è questa: e la non è prefazione, da che io non presumo di darti un libro d' autore. Onde discorrerò teco quanto nelle altre lettere con gli amici miei; e con pari sincerità. E quand' anche tu non l' accolga con pari fiducia, t' accorgerai, spero, ch' è lettera d' uomo ad uomo.

I miei pareri intorno agl' Inglesi derivarono tutti da sentimenti istantanei, spassionati d' astio o d' amore; ond' io li tengo per equi:—ma a promettergli giusti bisognerebbero esperimenti più cauti e più lunghi. Se non che il troppo esaminare assedia il giudizio di dubbj, e disanima la fantasia, che, quasi ispirazione, ci muove ad esprimere ingenuamente i sensi e i pensieri destati in noi dalla presenza di cose nuove.

A quanto dico de' miei concittadini troverò forse contraddittori;—non però credo che nessuno mai potrà smovere nella mia mente opinioni avveratemi da molti anni di prove, dalle calamità dell' Italia, e dal mio proprio dolore.

(FOSCOLO, il Gazzettino del Bel-Mondo.)

III.

GRAMMATICAL QUESTIONS.

1. Give the gender and the plural number, with the appropriate definite article, of the following nouns:—monaca, tribù, legista, occhio, tempio, arte, serie, clima, bue, scoglio, ginoco, crisi.

2. Form the adverbs from the following adjectives and participles:—celato, mortale, leggiero, avido, vezzoso, militare.

3. Write the conjunctive personal pronouns for the three persons in both genders and numbers in the dative and accusative cases.

4. Write the whole present tense of the indicative of venire; the preterite of volere; the future of potere; the imperative of andare; the subjunctive present of aprire; the subj. imperfect of stare; the participle past of the verbs fare, chiedere, offendere, scegliere, perdere, rispondere, morire, conoscere, divenire.

SPANISH.

THREE HOURS ALLOWED.

Candidates for the first-class are to translate an English passage into Spanish, to render in English several proverbs and idiomatic phrases, and to write in Spanish a short essay.

Translate into Spanish:—

Sancho came up to his master so faint and so dispirited,

that he was not able to urge his ass forward. Don Quixote, perceiving him in that condition, said, "Honest Sancho, that castle or inn, I am convinced, is enchanted, for they who so cruelly sported with thee, what could they be but phantoms and inhabitants of another world? I am confirmed in that, for, having found that when I stood at the pales of the yard, beholding the acts of your sad tragedy, I could not possibly get over them, not even alight from Rocinante, so that they must certainly have held me enchanted, for I swear to you, by the faith of what I am, that, if I should have got over, or alighted, I would have avenged you in such a manner as would have made those poltroons and assassins remember the jest as long as they lived, even though I would have thereby transgressed the laws of chivalry, for, as I often have told you, they do not allow a knight to lay his hands on his sword against any one who is not so, unless it be in defence of his life and person, and in cases of extreme necessity." "And I, too," quoth Sancho, "would have revenged myself, if I had been able, knight or no knight, but I could not; though, in my opinion, they who diverted themselves with me, and at my expense, were not hobgoblins, but men of flesh and bones as we are, and each of them, as I heard while they were tossing me, had his proper name. One was called Pedro Martinez, another Tenorio Fernandez, and the landlord's name is John Polomeque, the left-handed: so that, sir, as to your not having been able to leap over the pales, nor to alight from your horse, the fault lay not in the enchantment, but in something else. And what I gather clearly from all this is that these adventures we are in quest of will, in the long run, bring us into so many misadventures that we shall not know which is our right foot; so that, in my poor opinion, the better and surer way would be to return to our village, now it is reaping time, and look after our business, nor go rambling from Ceca to Meca, and out of the frying-pan into the fire."

Don Quixote, translated by Jarvis, cap. xviii.

Translate into English:—

PROVERBS AND IDIOMATICAL EXPRESSIONS.
1. Ahora que te veo, me acuerdo.
2. No hay caballo, por bueno que sea, que no tropiece.
3. Perro ladrador no es mordedor.
4. No es razonable andar á caza de gangas.
5. Si quieres no errar, cosete la voca.
6. Su padre le calentó las orejas.
7. Mi amigo está en candelero.
8. No hay mas cera que la que arde.
9. Nos dió con las puertas en los ojos.

Write a short essay on any subject in Spanish.

Candidates for the second-class certificate will have to translate the half of the preceding extract, five of the idiomatical expressions, and the two next chistes.

Al ir un general á dar una batalla á los persas, le dijo un soldado medioso, mi general, es preciso ir con cautela con los persas, porque son tan numerosos sus ejercitos que con sus flechas cubren el sol. Tanto mejor replicó el general asi pelearémos á la sombra.

Preguntando uno á un viagero, ¿si sabia cual era la mejor cosa? respondió: la libertad. ¿I la mas gustosa? la ganancia. ¿I la mas conocida? la fortuna. ¿I la peor? la muerte. ¿I el mas dichoso del mundo? el hombre sabio, rico y con salud. ¿I el mas desgraciado? el anciano sin bienes. ¿I el mas importuno? el hablador. ¿I el mas peligroso? el medico ignorante. ¿I el mas digno de compasion? el mentiroso que no es creido, cuando dice verdad.

Candidates for the third-class certificate will have to translate into English the next extract from Gil Blas, and translate into Spanish some phrases for the elucidation of irregular verbs and other grammatical rules.

Translate into English:—

Sirviéronme un copioso plato de manos de carnero fritas y lo comi casi todo: bebí á proporcion, y despues

fuime á la cama. Era esta muy buena, y esperaba que luego se apoderaria de mis sentidos un profundo sueño, pero engañéme, porque apenas pude cerrar los ojos, ocupada la imaginacion en que genero de vestido habia de escojer. ¿Que haré? me decia, ¿seguiré mi primer impulso de comprar unos habitos largos para ser domine en Salamea? Pero ¿ á que fin vestirme de estudiante? ¿Tengo yo deseos de consagrarme al estado eclesiastico? ¿Acaso me inclina á ello me propension? Nada de eso: mis inclinaciones son muy contrarias á la santidad que piden: quiero ceñir espada, y ver de hacer fortuna en el mundo I á esto me decidí.

Resolví, pues, vestirme de caballero bien persuadido de que esto bastaria para alcanzar un empleo de importancia. Con tan lisonjeros proyectos estuve esperando el dia con grandisima paciencia, y apenas rayó en mis ojos la primera luz, cuando salté de la cama. Hice tanto ruido én el meson que despertáron todos. Llamé á los criados que estában todavia en la cama, y me respondiéron echandome mil moldiciones. Al fin se viéron obligados a le vantarse y les dí orden de que fuésen á buscar el prendero. No tardó mucho en llegar este con dos mozos cargados, cada uno con un envoltorio Saludome con grandes cumplidos y me díjo, Caballero, ha hecho bien y V ha tenido gran fortuna en dirigirse á mí mas bien que á otro; no quiero desacreditar mis companeros; mas aqui para nosotros dos, ninguno de ellos sabe lo que es conciencia: todos mas duros que judios; yo soy el unico de mi oficio que la tiene; me limito á una ganancia justa y razonable, contentandome con un real por cada cuarto, equivoquéme quise decir con un cuarto por real. Despues de este preambulo, que yo creí al píe de la letra, mandó á los mozos que desatasen los envoltorios.

Gil Blas, cap. xiv.

Translate into Spanish:—

1. They loved each other, and their fondness increased with time.
2. You must depart immediately; there is not a moment to lose.
3. She likes this bonnet, but does not like the other at all.
4. Forty-five houses in the village.
5. A city with two hundred and thirty-six thousand souls.
6. Eighty-four chapters in the first volume, and nearly a thousand pages.
7. A score of people in the theatre.

FREE-HAND DRAWING.
THREE HOURS ALLOWED.

Candidates are not required to attempt all the following subjects.
1. Make a drawing of the bird or birds, either in the cage or out of the cage.
2. Make an outline of the perambulator.
3. Draw from memory either a human head, or some foliage of a tree, or a tombstone.
4. State what you know of the proportions of the human figure. [Every candidate is expected to reply to this question; and if he does not know anything of the proportions of the figure he must say so.]

DIRECTIONS FOR THE LOCAL BOARD.
Place a cage or coop, containing birds or fowls, before the candidates in free-hand drawing. The bottom of the cage or coop to be between three and four feet from the ground.
Put a perambulator or child's carriage on a table.

GEOMETRICAL DRAWING.
THREE HOURS ALLOWED.

The constructions must be accurate, and show clearly, by plain and dotted lines, with appropriate letters of reference, the principles on which they are based. No construction by trial nor calculation will be admitted.

They may be put in ink or left in pencil, at the discretion of the candidate, provided they are distinct.

No deviation from the conditions of the questions can be admitted; and since no candidate must answer more than two questions from any one section, he is advised not to attempt more than the time will admit of his completing, since little or no credit will be given for incomplete or inaccurate constructions.

Observation.—Whatever the number of questions the candidate constructs, one-half must be from the Solid Geometry.

I.
Construct a six-sided polygon A B C....F from the following conditions:—

Sides.	Angles.
A B = 1·5 inches	A B C = 100°
B C = 2 „	B C D = 110°
C D = 2·25 „	C D E = 120°
D E = 2·5 „	D E F = 130°
E F = 3 „	

Write down the length of the side F A, and the angles E F A, F A B.

II.
A line, A B, 3·5 inches long, is to be divided in the points C D, according to the following conditions:—
1. A C : C D : D B :: 1·75 : 2·25 : 3.
2. A C : C B :: A B : B D (The point D will be in A B produced).
3. $A C \cdot B D = A D \cdot B C$ (A C to be 1·25 inches and D in A B produced).

III.
Construct a triangle from one of the following conditions:—
1. Its area 6 square inches; its sides as 2 : 2·5 : 3.
2. Its area 6 square inches; its sides equal.
3. Isosceles, its base 2 inches, and the angles at the base double of that at the vertex.

IV.
Draw a triangle, its sides being 2·5; 3; 3·25 inches.
1. Construct an equilateral triangle equal to it in area.
2. Construct a square of twice its area.
3. Construct a triangle *similar* to it of twice its area.

V.
1. A point P is 2 inches from the centre of a circle of 1·25 inches radius; draw a line through P, cutting the circumference C D, so that $P C \cdot P D = C D^2$
2. Draw two other circles to touch the first and also each other, so that the *areas* of the three may be as 1 : 2 : 3.
3. Circumscribe the first circle by a triangle, having its sides as 2 : 2·5 : 3, and having one of its angles at P.

SOLID GEOMETRY.
(These constructions to be made explicit by a consistent notation, and by *indices* where required.)

VI.
1. Represent, by means of any two lines lying in it, a *plane* inclined to the paper at 50°.
2. Represent a plane inclined at 50° to the paper, and another perpendicular to the first but inclined at 70°.
3. Represent three planes, each perpendicular to the other two, the intersection of two of them being inclined at 30°.

VII.
A triangular pyramid has its edges 2″·25; 2″·5; 3″; 3″·25; 3″·5; 3″·75;
1. Draw its *plan* and *elevation* when it is standing on any of its four faces on the paper.
2. Draw its plan and elevation when its longest edge is vertical.
3. Determine the form of the section of this solid made by a plane bisecting any two of its edges, and passing through its centre of gravity.

VIII.
An octagon of 1 inch side is the base of an *oblique* prism, the edges of which being inclined at 70° to that

base, are 4 inches long, and parallel to a vertical plane passing through a diameter of the base.

1. Show the plan of this solid when standing on its base and an elevation on a plane not parallel to the edges.

2. This prism is bisected by a plane perpendicular to the edges; draw the real form of the section.

3. Draw the plan of one of the frusta when standing on the plane of the section.

IX.

An *oblique* pyramid has an octagon of 1 inch side for its base; its axis, which is 4 inches long and inclined to the base at 70°, lies in a vertical plane, passing through a diameter of the base.

1. Show the plan of this solid when standing on its base, and an elevation on a plane *not* parallel to the axis.

2. Draw the plan and an elevation when the shortest edge is either vertical or horizontal.

3. Determine the plan of the frustum cut off by a plane perpendicular to the axis, and passing through the centre of gravity of the solid when that frustum stands in the plane of the section.

X.

A right cone and a cylinder, each 4 inches high, and their bases 3 inches in diameter, and a sphere 3 inches in diameter; to be represented by plan and elevation.

1. When the cone lying on its side on the paper, the sphere also lying on the paper, touches the cone in a point at $\frac{1}{3}$ of the distance from the vertex to the circumference of the base.

2. When the cylinder standing on its base touches the cone in a point with the same condition.

3. When the cylinder lying on its side, the cone standing on its base touches the cylinder, and the sphere touches both.

XI.

Determine the shadow of one of the above solids, as cast by a luminous point 6 inches above the paper, when

1. Perpendicularly over the vertex of the cone, when lying on its side on the paper.

2. When 4 inches from the surface of the sphere, lying on the paper.

3. When in a vertical plane touching the side of the cylinder, lying on its side on the paper.

(In each case the line or lines on the curved surfaces, which separates the part in light from the part in shadow, to be shown).

THEORY OF MUSIC.

THREE HOURS ALLOWED.

RUDIMENTS OF MUSICAL GRAMMAR.

1. Write the following, *at the same pitch*, on the bass stave:—

2. Transpose the following into *Si b* (B b):—

3. Add a minor second to *a*, a major third to *b*, a perfect fourth to *c*, and an imperfect fifth to *d*.

4. Write the following in $\frac{6}{8}$ time:—

5. Write the following in a more modern and intelligible form:—

6. Simplify the following, by placing the *essential* sharps in the signature:—

7. Write the signatures of *Mi b* (E b), *Fa* (F), *Sol* (G), and *La b* (A b), major; and of *Si* (B), *Do* (C), *Re* (D), and *Mi* (E), minor.

8. Write from memory the psalm-tune (melody only) *Bedford*, or *London New*, or any other.

HARMONY.

1. Add three parts to the following:—

2. Write discords of the dominant seventh, and their resolutions in the keys of *Do* (C), *Re* (D), *Mi b* (E b), and *Fa* (F).

3. Harmonize the following:—

4. Put the following into score for soprano, alto, tenor, and bass:—
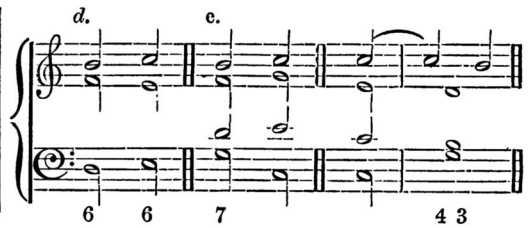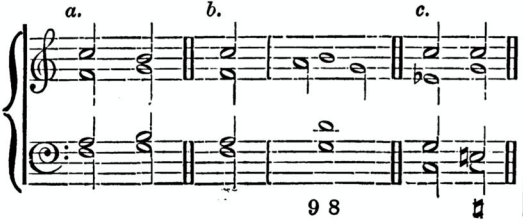
5. Add a part or parts, in any kind of counterpoint, *above* the following:—

6. Add a part or parts, in any kind of counterpoint, *below* the following :—

7. Correct the errors in the following without altering the extreme parts—treble and bass :—

8. Place the following names of composers in chronological order, under the following headings—the names of the countries of one or other of which they are natives — *Italy, Germany, England, France :*— Purcell, Mozart, Weber, Tallis, Rameau, Callcott, Mendelssohn, Rossini, J. Sebastian Bach, Auber, Blow, Palestrina, Morley, Bishop, Marenzio, Haydn, Webbe, Handel, Lully, Arne, Spohr, Carissimi, Orlando Gibbons, and Beethoven.